

CLAIMS

What is claimed:

5 1. A method for embedding watermark, comprising:

(a) evaluating in a predetermined manner a characteristic value for a signal within a frame obtained by segmenting the signal to be watermarked in a predetermined time period;

10 (b) determining a quantized value most closely approximated to said characteristic value by comparing said characteristic value with said quantized value within a set among a plurality of sets including one or more quantized value respectively, said set corresponding to a value of 15 pattern information embedded into the frame;

(c) evaluating an intensity of insertion used in order to modify the signal within the frame so that the characteristic value is the same as the quantized value determined in the step (b); and

20 (d) modifying the signal within said frame based on said intensity of insertion.

25 2. The method according to claim 1, further comprises filtering the signal through a predetermined range of frequency before said step (a), wherein said characteristic value for said filtered signal is evaluated in said step (a).

3. The method according to claim 1, further comprises
detecting a silent part within the signal, wherein said step
(a) to (d) are performed for a frame including the signal
5 excepting said silent part.

4. The method according to claim 1, wherein said pattern
information includes an error detecting code or an error
correcting code.

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5. The method according to claim 1, wherein said pattern
information includes a synchronizing signal.

6. The method according to claim 1, wherein said pattern
15 information consists of one bit for each frame.

7. The method according to claim 1, wherein said pattern
information consists of a plurality of bits for each frame.

20 8. The method according to claim 7, further comprises
filtering the signal through a plurality of ranges of
frequency with a respectively different range of a band
before said step (a), wherein said plurality of bits is
inserted respectively into each of signals filtered through
25 said plurality of ranges of frequency.

9. The method according to claim 1, wherein said characteristic value is evaluated as follows:

$$F = \frac{S_A - S_B}{S_A + S_B}$$

$$S_A = \sum_{t=i-1}^{i-1/2} s^2(t) \quad , \quad S_B = \sum_{t=i-1/2}^i s^2(t)$$

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(Herein, $s(t)$ means a signal within a frame to be watermarked, $i-1$, $i-1/2$ and i respectively mean notations indicating a starting point of range A, an ending point of A (or a starting point of range B), and an ending point of 10 range B when a frame is segmented into range A and range B, and F means a characteristic value).

10. The method according to claim 1, wherein said characteristic value is evaluated as follows:

$$F = \frac{S_A - S_B}{S_A + S_B}$$

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$$S_A = \sum_{t=i-1}^{i-1/2} |s(t)| \quad , \quad S_B = \sum_{t=i-1/2}^i |s(t)|$$

(Herein, $s(t)$ means a signal within a frame to be watermarked, $i-1$, $i-1/2$, and i respectively mean notations indicating a starting point of range A, an ending point of A 20 (or a starting point of range B), and an ending point of range B when a frame is segmented into range A and range B,

and F means a characteristic value) .

11. The method according to claim 1, wherein said step (d) is performed as follows:

$$\begin{aligned} \text{RANGE A : } s'(t) &= s(t) + g \cdot s(t) \\ \text{RANGE B : } s'(t) &= s(t) - g \cdot s(t) \end{aligned}$$

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(Herein, range A and range B mean notations indicating each range when a frame is segmented into two ranges,

$s(t)$ is the signal within a frame to be watermarked,

g is an intensity of insertion, and

10 $s'(t)$ is a signal obtained by modifying the signal $s(t)$ in said step (d) so that said characteristic value is the same as said quantized value)

12. A method for detecting a watermark from a signal into 15 which the watermark is embedded according to the method described in claim 1, comprising:

(e) evaluating a characteristic value for the signal within a frame obtained by segmenting the signal in a predetermined time period in accordance with the same manner 20 in said step (a) ;

(f) determining a quantized value most closely approximated to said characteristic value by comparing said characteristic value evaluated in said step (e) with each quantized value within a plurality of sets of said quantized

values used for a quantization of said characteristic value in embedding said watermark; and

(g) extracting a value corresponding to the set of quantized values involving said quantized value determined 5 in said step (f), as a pattern information embedded into said frame.

13. The method according to claim 12, further comprises filtering the signal through a range the same as a range of 10 a frequency for filtering in embedding said watermark before said step (e), wherein said characteristic value for said filtered signal is evaluated in said step (e).

14. The method according to claim 12, further comprises 15 detecting a silent part within the signal, wherein said step (e) to (g) are performed for a frame including the signal excepting said silent signal.

15. The method according to claim 12, further comprises 20 performing operation for an error detecting or an error correcting for a bit string of said pattern information extracted in a sequence from each frame.

16. The method according to claim 12, further comprises 25 detecting a synchronizing signal from said extracted pattern

information.

17. The method according to claim 12, wherein said pattern information inserted into said one frame consists of a 5 plurality of bits inserted respectively into a plurality of ranges of frequency with a respectively different range of a band,

and said method further comprises filtering the signal through said plurality of ranges of frequency before said 10 step (e),

wherein said step (e) to (g) are performed for each filtered signal.